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Trade- GDP Nexus in Nigeria: An Application of Autoregressive Distributed Lag (ARDL) Model

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Abstract
This study examined Trade-GDP nexus in Nigeria using the autoregressive distributed lag(ARDL) approach. The study covers the periods 1970-2012, employing data sourced from Central Bank of Nigeria Statistical Bulletin of various issues. Econometric evidence revealed that trade openness; foreign direct investment and exchange rate were some of the key factors that explained the trade-GDP nexus in Nigeria. In addition, the estimated ECM result revealed 31% speed of adjustment between the dependent variable (RGDP) and independent variables (TOP, FDI and EXR). Findings from the study also showed that the endogenously determined variables of (TOP, FDI & EXR) are jointly significant in explaining changes in Nigeria's economic growth. However, trade openness and exchange rate management influences economic growth negatively because of unfavourable terms-of-trade between Nigeria and her trading partners and the continuous depletion of the external reserves. We therefore recommend among others, expansion of the economy's export base by complete diversification of the economy away from the oil enclave as well as effective exchange rate management in Nigeria by the monetary authorities.
Keywords: Trade, economic growth, ARDL co -integration.
JEL Classification: F43, F14, C32

1. Introduction

The role of export in economic performance of developing countries like Nigeria has become one of the most intensively debated issues over the years. The performance of a given economy in terms of growth rate of output and per capita income has not only been based on the domestic production and consumption activities but also on the exchange of goods and services across country frontiers.

In the 1960's and early 1970's, Nigeria's exports trade was largely dominated by non-oil products, example, cocoa, rubber, palm oil and cotton to mention but few. Nigeria's total export of about 66% within these periods was accounted for by these commodities. Overall, agricultural output accounted for 70.8% of the revenue while oil accounted for the rest per cent of revenue. However, there was a change in the trend within the periods of 1973-1974 where oil and its revenue became the major income earner of the Nigerian economy followed by agricultural productivity. The oil boom affected the economy negatively. According to Ehinomen and Oguntona((2012) the crux of the matter was that while oil export was growing positively, non-oil export were declining negatively making the dominance more rapid and pervasive.

Nigeria, like other developing countries has initiated and altered commercial or trade policies to affect their terms of trade, balance of payments positions and the exchange rate problems. In particular, the trade liberalization policy embarked upon by the Nigerian government in 1986, as an element of the structural adjustment programme (SAP) , was aimed at reducing the effective rate of protection , thus lessening export bias and to a large extent , liberalize imports. It was targeted at removing the over-valuation of the naira exchange rate thereby increasing the competitiveness of Nigeria's exports with a resultant effect of stimulating the production and diversification of export goods to include manufactured exports. Under the policy environment, there was exchange rate and enhanced implementation of export promotion strategies. For example, the naira was depreciated from ₦1.60K to $1 in 1986 to over ₦96 to $1 in 1999. Moreover, the performance of the non-oil exports improved unsatisfactorily. The share of non-oil exports to total exports rose from 6% in 1986 to 9% in 1988 but fall to 4% in 1991, with some evidence of diversification. The manufactured exports as a percentage of total exports rose from 0.04% in 1986 to 0.92%. The unsatisfactory performance of the manufactured component of non-oil exports relative to the extent of incentives and other unsatisfactory conditions within the economy questions the rationale of the various trade policy regimes in Nigeria.

The general objective of the study is to investigate the effects of trade openness on the growth of the Nigerian economy between the periods 1970-2012. This study is a further contribution to the already existing body of knowledge of Trade- GDP nexus in Nigeria.

The sequence of this study is clear. Following this introduction/background section is the literature review as discussed in section 2. The theoretical foundation on which the model is predicated and model specification is in section 3. Thereafter, the estimation and discussion of empirical results are presented in section 4. The study is rounded-up with conclusion and recommendation for policy action in section 5.

2. Literature Review

In this section, we survey the literature on trade-gdp nexus and aims at laying the theoretical foundation of the study. Theoretically, some factors have been identified as determinants of economic growth. They include: domestic investment (Solow, 1956; Romer and Lucas,1982), economic policies and macroeconomic conditions(Kormendi & Meguire, 1985; Barro,1991, 1997; Fischer,1993), foreign direct investment(Lensink,2000; Lensink and Morrisey,2006), institutional framework(Lewis, 1995; Ayres,1962; Esaterly ,2005), political regimes(Lipset, 1959), socio-cultural factors(Hungtington,1996,, Temple & Johnson, 1998; Landes, 2000; Zack & Knack, 2001; Barro & Mccleary, 2003 and ethnic diversity(Easterly & Levine, 1997).

Some authors have attempted to examine empirically the impact of trade openness on the economy. For example, Ram (1986) and Levine and Renelt (1992) explored the effect of public expenditure on economic growth using cross-country regression. They found that, although growth is generally positively correlated with the rate of change in total expenditure, it is negatively correlated with the level of such expenditure. Evidence exists on the relationship between the extent of financial intermediation and economic growth. In that study, Lanyi and Saracoglu (1983) found a high degree of correlation between the growth rate of the GDP and that of the broad money supply, with the latter variable being statistically significant at the one percent level.

Djeri – Wake (2009) studied the impact of China investment and trade in Nigeria's economic growth within the periods of 1990-2007 employing the Augmented Dickey Fuller (ADF) econometric test, ordinary least square (OLS) and Granger causality test. He discovered that in the short – term, Nigeria – China bilateral trade relationship doesn't contribute to Nigeria's economic growth but long – term relationship enhances Nigeria growth. A different result was gotten by Evans (2007) in his own study on the impact of trade openness and economic performance of ECOWAS members. He concluded that there exist unique long – run relationship between economic performance, trade openness, government expenditure, labour force and real capital stock for both Ghana and Nigeria.

Daumal and Ozyurt (2011) examined the impact of international trade flows on economic growth in Brazilian states using dynamic regression with system GMM estimator. The authors found out that trade openness are more beneficial to states with a high level of initial per capita income and contributes to increased regional disparities in Brazil. Kareem (2007) explained a different situation under Nigerian economy. He discovered that there is no significant relationship between trade flows and employment in Nigeria in both the short – term and long-term period.

Alimi and Atanda (2011) examined the effects of globalization on economic growth in Nigeria between 1970 and 2010 amidst cyclical fluctuations in foreign investments. They employed the autoregressive model approach in their study and found out that globalization and cyclical movement in foreign investment have significantly enhanced economic growth in Nigeria.

In the same Vein, Ajayi and Atanda (2012) investigated trade and capital flow channel of globalization on macroeconomic stability as proxy of real output growth rate in Nigeria between 1970 and 2009. The employed autoregressive model indicated that the first lag of real output growth rate has significant positive effect on real current growth rate, while the second autoregressive term is found to exert insignificant negative effect on current real output growth rate.

Ehinomen and Oguntona (2012) examined the causality between export and economic growth in Nigeria. The results of the study indicated that there exist a uni-directional relationship between export and economic growth.

3 Theoretical Framework and Methodology

This section basically defines the analytical framework underpinning the study. The various theoretical postulations of economic growth include: classical models, neo-classical models, endogenous growth model and the export-led model. However, the framework of the study is the-Export-led model which is briefly described hereunder. Theoretically, export is a factor for economic growth; hence an increase in export trickles down to increase in employment in export sector industries which in turn increases income and GDP. Secondly, export supports foreign exchange earnings which also assist in importing capital goods and intermediate goods (Awokuse, 2005). Furthermore, export growth is one of the key determinants of economic growth. It therefore holds that the overall growth of an economy can be generated not only by increasing the amounts of labour and capital within the economy but also by expanding exports such that exports can perform as an engine of growth. Some empirical studies have been carried out on the relationship between exports and economic growth using the export-led growth hypothesis. They include: Musonda(2003) for Zambia, Andre and Joel (2007) for Botswana to mention but few. All their results using different approaches support the export –led growth hypothesis.

3.1 Model Specification

Using the export-led growth hypothesis as the theoretical framework and adapting the models of Kim's (2008), Oluwaseyi and Adejoke (2013) with modification. Kim's(2008) model is specified as follows

$$y_{gt} = \alpha + \beta td + \varnothing w + u \text{ ---------- (1)}$$

Where: yg = growth rate of per capital GDP, td = total trade openness (i.e exports and imports to gross domestic product), W = vector of conditional variables; α = intercept or constant, β, $\varnothing$ = parameters or coefficient of explanatory variables, and u = error term.

According to Kim (2008), the vector of conditional variables includes initial real GDP per capital to control for convergence, average year of schooling to proxy the level of human capital in the economy and policy variables like inflation rate as a measure of economic stability, ratio of government expenditure to GDP, and financial development indicator proxy as bank credit to private sector as a share of GDP. Oluwaseyi and Adejoke (2013) model is specified as follows:

$$\text{In } RY_t = \alpha + \beta \text{InTRO}_t + \phi_1 \text{INRY}_{t-1} + \phi_2 \text{InFIN} + \phi_3 FSD_t + \phi_4 INF_t + \phi_5 LER_t + U \text{ ---------- (2)}$$

Where RY = Real gross domestic product, FIN = Foreign Investment, proxy for foreign private investment, FSD = Financial sector development proxy for domestic credit to the private sector as a ratio of GDP, INF = Inflation rate, LER = lending rate proxy for monetary policy, α = Intercept or constant, β, $\varnothing$ = parameters or co-efficient of explanatory variables, and U = error term.

Therefore, following both models with modifications, the model of our study is stated thus: $\text{In } RY_t = \lambda + \varnothing_1 \text{InTOP}_t + \alpha_1 \text{INRY}_{t-1} + \phi_2 \text{InFDI} + \phi_3 \text{EXR} + \beta$ --- (3)

$$\varnothing_1 > 0, \phi_2 > 0, \phi_3 > 0$$

Where: Ry_t = real gross domestic product at time t, TOP_t = Trade openness (import and export to ratio of GDP), EXR = exchange rate, external sector development, α and ϕ = parameters or coefficient of explanatory variables and ε = stochastic error term. The variables used in the study are annual time series data sourced from the Central Bank of Nigeria Statistical Bulletin (of various issues) between the periods 1970 to 2012. The variables are measured as follows. RY is measured as the real gross domestic product, TOP is measured as the degree of trade openness (export and import as a ratio of GDP, FDI is measured as the foreign direct investment and EXR is measured as the exchange rate, a proxy for the external sector development.

4 Estimation Techniques and Discussion of Empirical Result

Equation (3) will be estimated using the ordinary least square (OLS). However, before the estimation, it would be useful to determine the underlying properties or processes that generate our time series variables, whether the variables are stationary or non-stationary. Macro econometric data often appear to possess a stochastic trend that can be removed by differencing the variables. The unit root test will be carried out using the Augmented Dickey Fuller test (ADF) while the co-integration test will not be based on the Johansen/Juselius approach but on the advanced Autoregressive Distributed Lag (ARDL). Recently, a series of studies by Pesaran and Shin (1996); Pesaran and Pesaran (1997); Pesaran and Smith (1998) and Pesara et al (2001) have introduced an alternative co-integration technique known as the Autoregressive Distributed lag (ARDL) model/bound f- test. This technique has a number of advantages over and above the Johansen co- integration technique. First, the ARDL model is the more statistically significant approach to determining the co-integration relationship in small samples (Ghalak and Siddiki, 2001), while the Johansen co-integration technique requires large data samples for validity. Second, the ARDL approach of co-integration requires all of the regressors to be integrated of the same order, while the ARDL approach can be applied whether the regressors are I (1) and I (0). This means that the ARDL approach avoids the pre-testing problems associated with standard co-integration, which requires that the variables be already classified into I(1) or I (0) (Pesaran et al, 2001). As Bahmani Oskooee (2004) explains, the first step in any co-integration technique is to determine the degree of integration of each variable in the model but this depend on which unit root test one uses and this may further include the Augmented Dickey Fuller and the Philips – Perron tests. Therefore, it can be incorrectly concluded that a unit root is present in a series that is actually stationary around a onetime structural break (Perron, 1989, 1997). The ARDL approach is useful because it avoids these problems. Again, with the ARDL approach, it becomes possible that different variables have different optimal numbers of lags, which is not applicable in the Johansen approach.

Accordingly, the ARDL approach requires the following two steps. In the first step, the existences of any long – term relationship among the variables of interest is determined using an F – test. The second step of the analysis is to estimate the coefficient of the long – run relationship and determine their values, followed by the estimation of the short – run elasticity of the variables with the error correction representation of the ARDL model. By applying the ECM version of ARDL, the speed of adjustment to equilibrium will be determined. According to Pesaran and Pessaran (1997), the ARDL model is represented by the following equation:

$$\phi(L, P)\, y_t = \sum_{i-1}^{k} \beta_i (L, q_i)\, x_{it} + \delta W_t + U_t \text{ ---------- (4)}$$

Where: $\phi(L, P) = 1 - \phi_1 L - \phi_2 L^2 - \ldots \phi_p L^p$ and

$$\beta_i (L, q_i) = 1 - \beta_{i1} L - \beta_{i2} L^2 - \ldots \beta_i q_i L^{qi},\ I = 1, 2\ldots, k$$

Where y_t is the dependent variable, x_{it} denotes the i dependent variables, L is a lag operator, and W_t is the S x I vector of deterministic variables, including intercept terms, dummy variables, time trends and other exogenous variables.

The ECM version of the ARDL model can be obtained by rewriting equation (4) in terms of the lagged levels and first difference of y_t, x_{1t}, x_{2t} … x_{kt} and Wt as follows:

$$\Delta y_t = -\phi(1, P)\, EC_{t-1} + \sum_{i=1} B_{i0} \Delta X_{1t} + \delta^1 \Delta W_t - \sum_{j=1} \phi^* y_{t-j}$$

$$-\sum_{i=1}^{k} \sum_{j=1}^{q_{t-1}} \beta_{ij}{}^* \Delta X + U_t \text{ ---------- (5)}$$

The error correction term is defined by:

$$EC_t = y_t - \sum_{i=1} \hat{\theta}_i\, x_{it} - \psi_1 W_t \text{ ---------- (6)}$$

Where; ϕ^*, δ^1 and β_{ij}^* are the coefficients which is related to the short – run dynamics of the model's convergence to equilibrium, and $\phi(1, P)$ is the speed of adjustment. Following the ARDL model (p, q) of equation (3), we formulate the Unrestricted Error Correction Model (UECM) as follows:

$$\Delta y_t = \sum_{j=1}^{P-1} \beta_j \Delta \hat{Y}_{t-1} + \sum_{j=1}^{P-1} \alpha_j \Delta x_{t-j} + \phi\, [Y_{t-1} - \{\beta + \delta_i X_{t-1}\}] + U_t \text{ ----------(7)}$$

Where Δy_t is differenced stationary economic growth variable (RGDP), Δx_t is a vector of differenced stationary explanatory variables (TOP, FDI and EXR), β and α are short – run coefficients of the determinants of economic growth in our model. As discussed earlier, in the first step we need to capture the usual f-statistic for testing the null hypothesis (of no co-integration defined by (H_0: δ1 = δ2 = δ3 = δ4 = δ5 =0) among the levels of the included variables in the models. The F-statistics are calculated to check the null hypothesis. The calculated F – statistics is compared with the critical value tabulated by Pesaran et al (2001). These critical values are calculated for different regressors and whether the model contains an intercept and a trend. Again, according to Bahmani – Oskooee (2004), these critical values include an upper and a lower band covering all possible classifications of the variables into I(1), I (0) or even fractionally integrated. The null hypothesis of no co-integration is rejected if the calculated F – statistic is bigger than the upper bound. If the computed F – statistic is smaller than the lower bound, the null hypothesis cannot be rejected. If it falls in between the lower and the upper bound, then the result is inconclusive. In such an inconclusive case an efficient way of establishing co-integration is by applying the ECM version of the ARDL model which in this scenario, is specified as follow:

$$\Delta y_t = \lambda_0 + \sum_{i=1}^{k} \lambda_1 \Delta y_{t-i} + \sum_{i=0}^{k} \lambda_2 TOP_{t-i} + \sum_{i=0}^{k} \lambda_3 \Delta FDI_{t-i} + \sum_{i=k} \lambda_3 \Delta EXR_{t-i} + ec_{t-I} + U_t \text{ ----8}$$

Where ec_{t-i} is the first lag of the stationary residual form long – run equation
Where ec_{t-i} is the first lag of the stationary residual form long – run equation

4.1 Unit Root Test

The Augmented Dickey – Fuller (ADF) test is used in testing the null hypothesis that there is a unit root in a particular time series of interest. The table is presented below

Table1: Unit Root Test

Variables	ADF statistic		Critical	Remark
	Level	Difference		
LRGDP	-5.975776	-	1% = -3.600957 5% = -2.935001 10%= -2.605836	1(1)
LTOP	-6.344164	-	1% = -3.600957 5% = -2.935001 10%= -2.605836	1(1)
LFDI	-6.281511	-	1% = -3.600957 5% = -2.935001 10%= -2.605836	1(1)
LEXR	-5.231840	-	1% = -3.600957 5% = -2.935001 10%= -2.605836	1(1)

Notes: One lag of each variable is used. The variables are defined as follows: RGDP stands for real gross domestic product, TOP stand for trade openness, FDI stands for foreign direct investment and EXR stands for exchange rate.

The results in Table I revealed that all the variables are stationary after first difference. The unit root test applied to the variables at levels accepts the null hypothesis of stationarily of all the variables. Thus, the variables are integrated of order one. Given the unit – root properties of the variables, we proceed to establish whether or not there is a long – run co-integrating relationship among the variables using the autoregressive distributed lag approach (ARDL).

4.2 Co-integration Test Result

In the estimation of the unrestricted error correction model of equation (7), we select the maximum lag length of the parsimonious model from general-to-specific method while checking the significance of the model coefficients. The appropriate lag order for this study is (1, 1, 1, 1) from which we obtain the result of the Bound test as presented in Table 2

Table 2: Joint F – Test on ARDL Bound Testing for Co-integration

Test statistic	Value	df	Probability
F-statistic	8.15088	(4,210	0.0076
Chi – square	12.60345	4	0.0134

Null Hypothesis: C (1) = C (2) = C (3) = C (4) = 0

Null Hypothesis Summary:

Normalized restriction (= 0)	Value	Std. Err
C (1)	-0.606125	0.239939
C (2)	-0.241146	0.174694
C (3)	0.287501	0.143155
C (4)	-9.124222	0.122091

Critical values @ 95% confidence interval for (K + 1) = 4, ⇒ k = 3, Assuming Intercept and Trend

Lower Bound (0)	Upper bound 1 (1)
4.66	5.119

Source: author's computation

The F-statistics showed the results for each calculated variable when considered as a dependent variable in the ARDL – OLS regression. Hence, the calculated F-statistics is compared with the critical values for the bound test using the Pesaran et al (2001) approach. Thus the null hypothesis of no co-integration is rejected if the F-statistics is high than the upper bound critical values at the significant level chosen, and the null hypothesis of co-integration is accepted, if the F-statistic is lower than the lower bound critical value. Based on the statement above, a 5% level of significance is adopted for the critical values for the bound testing technique and therefore we deduced that the null hypothesis of no co-integration is rejected for the variables of real gross domestic product (RGDP), trade openness (TOP), foreign direct investment (FDI) and exchange rate (EXR) implying that the is a long – run co-integratiing relationship among the variables when normalized for Nigeria. The computed F-statistics of 8.15088 is greater than both the lower bound I(0) of 4.066 and upper bound I(1) of 5.119.

4.3 Long – Run Regression Result

Once long run co-integration relationship has been established, it becomes necessary to estimate the long – run

coefficients as shown in Table 3

Table 3: Long – Run Coefficient of the ARDL

Dependent Variable: LRGDP

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	1.042169	0.686248	1.518647	0.1374
LRGDP (-1)	0.757962*	0.132230	5.732166	0.0000
LTOP (-1)	-0.037364	0.112051	-0.333459	0.7407
LFDI (-1)	0.205250*	0.109090	1.881477	0.0678
LEXR (-1)	-0.052046	0.089129	-0.583945	0.5628

R-squared 0.960908, F-statistic = 227.3714*, DW = 2.091260

Note: *significant at 1%.

The result from the table implies that for a percentage increase in trade openness, foreign direct investment and exchange rate, current economic growth decreases by (0.04%), (0.21%), (0.05%) respectively. Table 3 also revealed that trade openness and exchange rate management was found to influence economic growth negatively and this effect does not conform to the theoretical presumption. This implies that a percentage increase in trade openness and exchange rate as measures of external sector development decelerates economic growth by 0.04% and 0.05%.The F-statistic result shows that the variables of trade openness, foreign direct investment and exchange rate are altogether significant at 5% critical level. While the adjusted R-square results showed that 96% of the total variation in economic growth is accounted for by the changes in trade openness, foreign direct investment and exchange rate appreciation. The Durbin – Watson test result of 2.091 showed that there is absence of serial autocorrelation. Furthermore, to find dynamic equilibrium between the short – run and the long-run relationship, we estimated the error correction model (ECM) and the result is presented (Table 4)

Table 4: Error Correction Model Results

Dependent Variable: LRGDP

Variable	Coefficient	Std. error	t-statistic	Prob.
C	0.112217	0.073281	1.531329	0.1347
D(LRGDP(-1)	0.207632	0.025753	8.062439	0.0000
D(LTOP (-1)	0.163215	0.106422	1.533659	0.0775
D(LFDI (-1)	0.235498	0.105531	2,231553	0.0478
D(LEXR9-1)	-0.233524	0.195957	-1.191713	0.2414
ECT (-1)	-0.306693	0.120322	-2.548935	0.0378

R – SQUARE	**0.725779**	**AIC**	**0.787213**
Adj R-Square	**0.630890**	**SBC**	**1.037980**
F – Stat	**21.00715**	**HQC**	**0.878529**
Prob (F-statistic)	**0.000093**	**D.W Stat.**	**2.04900**

The ECM is used to correct for disequilibrium i.e. it is used to reconcile the short – run behaviour of an economic variable with its long run behaviour. It should be noted that the greater the coefficient of the ECM, the quicker the speed of adjustment of the model from the short – run to the long – run. The ECM result and coefficient of (– 0.306693) is significantly and appropriately signed. Thus, the econometric and in extension the economic implication of the result is that about 30 % or 31% of the discrepancy between the long- run and short-run dynamics is corrected within the next year revealing a slower speed of adjustment between the dependent variable(RGDP) and the independent variables(TOP, FDI and EXR). Similarly, the good fit represented by the R-squared stood at 73% meaning that the explanatory variables of (TOP, FDI & EXR) accounted for 73% of the total change in the dependent variable (RGDP)

5 Conclusion and Recommendation

This study set out to estimate the Trade – GDP nexus in Nigeria over the periods 1970 to 2012. It was observed from the study that trade openness and exchange rate management influences economic growth negatively and that questions the effectiveness of the different trade and exchange rate policy regimes in Nigeria. Furthermore, it was observed that 30% or 31% of the discrepancy between the long-run and short-run dynamics of the associated variables are corrected within the next year.

The policy implication of the above results is clear. First, the government should expand the economy's export base by complete diversification of the economy away from the oil enclave, as the estimation result reveals negative influence of trade openness (oil export as a major export commodity) whose terms-of-trade(TOT) is negative. The results further shows by implication that the depletion of the external reserve of the

country existing side-by-side with negative terms of trade has led to the depreciation of the exchange rate vis-à-vis the dollar, as the Nigerian economy is experiencing now. This suggests that the monetary authorities can focus more on effective exchange rate management in Nigeria.

- **Future Research Agenda**

We suggest that future study along this line should consider the possibility of testing for structural breaks particularly during the (exchange rate and trade policies trade) reform periods. Furthermore, future studies could try alternative estimation techniques in order to enhance comparison and policy debate.

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